Acquisition Execution Plan

Run IIb CDF and DØ Detector Projects

at
Fermi National Accelerator Laboratory

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Introduction

This document describes the Acquisition Execution Plan for the Run IIb upgrades to the CDF and DØ experiments operating at the Fermilab Tevatron Collider. The upgrade of each experiment will be considered to be a separate project. The two projects are very similar from a technical and managerial point of view. Therefore, the common procurement issues between these projects motivates a single Acquisition Execution Plan to cover both projects. Specific differences between the two projects will be discussed in Appendices A and B.

A. Acquisition Background and Objectives

1. Statement of Need

The Fermilab Tevatron Collider brings circulating beams of high-energy protons and anti-protons into collision for the purpose of studying the fundamental constituents of nature. These collisions take place at two locations in the Tevatron Collider, and the remnants of these collisions are detected by the CDF and DØ experiments. By examining these remnants, the experiments are able to study the properties of the particles produced in these collisions, search for the production of new species of particles, and study the fundamental interactions that govern the production and decay of the particles.

The Fermilab Tevatron provides the highest energy particle beams in the world, enabling unique opportunities for scientific discovery. One such opportunity is the search for the Higgs Boson, which is thought to be responsible for breaking the Electro-Weak symmetry and giving rise to particle masses. Understanding the mechanism for Electro-Weak Symmetry Breaking has been identified as the highest priority of the US High Energy Physics (HEP) program by the HEPAP sub-panel assessing the long-range future of the field. There are strong indications that the Higgs mass is likely to be within the range where CDF and DØ experiments are sensitive to it provided the experiments collect sufficient integrated luminosity. The purpose of this acquisition is to provide technical components to upgrade the CDF and DØ experiments to enable them to accumulate sufficient integrated luminosity to maximize the chance for discovering the Higgs Boson.

Fermilab will continue to operate at the "Energy Frontier" until the Large Hadron Collider (LHC) at CERN begins operation with a much higher beam energy at the earliest in late FY2007. Thus, the Fermilab Tevatron Collider has a window of opportunity for making a major scientific discovery before handing off the baton to CERN and minimizing the procurement time for the Run IIb upgrades is a significant consideration in the project planning process. Estimates indicate that, due to radiation damage, the current silicon detectors will only be useful up to 4 fb^{-1}, which is expected to occur in about 2005. The original CDF and DØ Detectors underwent upgrades for Run IIa at a cost of approximately $210 million. The accelerator complex also underwent upgrades for Run II at a cost of approximately $300 million. To maximize the usefulness of this high-energy physics investment, the Run IIb CDF and DØ Detector Projects are essential. The detector components provided by the Run IIb upgrades will allow the experiments to operate at high luminosity and meet the laboratory's goal of acquiring an integrated luminosity of 15 fb^{-1}. This is a significant increase above the Run IIa goal of 2 fb^{-1} and will enable a sensitive search for the

Higgs Boson, which has been identified as a top priority in the President's budget request for High Energy Physics.

2. Applicable Conditions

Installation of the Run IIb projects will be required to continue operation beyond 2005, due to radiation damage to the current silicon detectors and to optimize data taking with the increased beam intensities. The DOE-approved procurement system at Fermilab will be used for procurement on these projects.

Considerable experience in the construction and operation of detector elements similar to those included in the Run IIb projects was gained by both experiments during the Run IIa CDF and DØ Upgrade Projects (CD-4 achieved March 2001). The new system designs will draw heavily on that experience.

3. Cost

The total project costs for the CDF and DØ projects have not yet been baselined, but are estimated to be approximately $25-35 million each including contingency. The projects will receive the majority of the funding from DOE via the Fermilab budget. Significant additional contributions from foreign sources are anticipated. In addition, several university groups will contribute to the projects and be supported by National Science Foundation grants and/or the DOE-supported university program. Labor for the Run IIb Collider Experiment projects will be provided by Fermilab and university supported researchers.

Life-cycle cost: Project costs are presented in the paragraph above. Operating costs for the Run IIb experiments will be comparable to the currently operating Run IIa experiments, because the components produced by these projects replace existing components and are expected to have comparable operating costs. The elements of the experiments built by the Run IIb projects will have a useful life of approximately five years. No significant costs are foreseen in the decommissioning of the Run IIb projects, since the upgrades are relatively small. In addition, the integrated exposure to radiation is extremely limited and should not introduce any contamination concerns during the decommissioning process.

Design-to-Cost: Laboratory management provided design-to-cost guidance. The estimated cost of approximately $15 million at the time of CD-0 approval was considered very preliminary. This figure was provided to the projects with an understanding that the actual cost is driven by technical requirements which are in turn driven by the physics goals and increased luminosity. The goal is to design the projects to minimize costs while achieving the scientific requirements. The purpose of the projects has remained unchanged from the time of the CD-0 approval: to provide necessary repairs and improvements to the CDF and DØ Detectors, enabling data taking in the high luminosity environment of Run IIb. The estimated cost has increased primarily as a result of maturation in the understanding of the proposed silicon detectors and the addition of smaller subprojects that are required for high luminosity operation. The silicon trackers represent approximately 80 percent of the projects' total cost estimates.

Application of should-cost: Although this effort does not explicitly use a detailed, special form of cost analysis as identified in Federal Acquisition Regulation 15.407-4, it has used an extensive amount of should-cost philosophy in preparing estimates. Detailed cost estimates of each of the major procurements for the Run IIb projects have been made from vendor quotes and experience with earlier and similar procurements. As a result, these cost estimates will serve as the should-cost benchmarks as these projects evolve and be utilized to estimate project procurement costs and explain any variances.

4. Capability

The Run IIb upgrades of the CDF and DØ detectors will provide the necessary capability to make sensitive searches for the Higgs Boson and maximize the physics opportunities in Run IIb. The largest part of the Run IIb projects is to provide replacement silicon detectors for the CDF and DØ experiments. These detectors are capable of identifying short-lived particles, such as b-quarks, that travel a small distance before decaying into other particles. The Higgs Boson is expected to decay into a pair of b-quarks and efficiently detecting them is crucial to the Run IIb goals. The CDF Run IIb project also includes a central preradiator detector with the capability of improving electron and photon identification, and an upgraded event builder with the capability of increasing the data throughput. The DØ Run IIb project will provide Level 1 and Level 2 trigger upgrades to improve the selectivity of data that will be recorded and an online computing upgrade to provide the necessary computing infrastructure needed for Run IIb.

5. Delivery or Performance Period Requirements

Current estimates indicate that the Run IIb Collider Experiment projects must be completed by November 2006. This date is dictated by the operational needs of the collider program and the anticipated lifetime of the currently operating detectors. The procurement process for several long lead time items needs to begin at the end of calendar year 2002, in order to maintain the schedule for the project. These items include silicon sensors, silicon detector readout chips, and the circuit boards that hold the silicon detector front end electronics. Important milestones for the projects are listed below.

Milestone	Date
CD-0 Approval	June 2001
CD-1 Approval	August 2002
CD-2 Approval	September 2002
CD-3 Approval	September 2002
Begin major procurements	December 2002
Begin Assembly	October 2003
CD-4 Approval	November 2006

6. Trade-offs

There are no tradeoffs associated with the acquisition execution plan.

7. Risks

Detector upgrades are well within the experience and expertise of the collider experiment collaborations; therefore, technical risks are minimal. Every effort has been made to specify these projects in a manner that reduces the level of risk to an acceptably low level. Risk identification and analysis will continue throughout the life of the project. The following steps will be taken to assure that the risk to these projects is low:

(1) Technical:

Preparation of clear and concise specifications, judicious determination of subcontractor responsibility and approval of proposed lower tier sub-subcontractors, and implementation of QA provisions will minimize technical risk. Projects have been designed to further minimize technical risk by exploiting previous experience to the greatest extent possible, and minimizing exposure to single vendor failures.

Technically risky elements of the silicon detectors for both experiments have been minimized by making deliberately conservative design choices. For example, use of single sided sensors, reduction in component variety, and common integrated circuit technologies will reduce risk.

(2) Cost

Use of fixed-price subcontracts and competition will be maximized to reduce cost risk.

(3) Schedule

Schedule risk will be minimized via:

- realistic planning,
- verification of subcontractor's credit and capacity during evaluation,
- close surveillance of subcontractor performance,
- advance expediting, and
- incremental awards to multiple subcontractors when necessary to assure total quantity or required delivery.

Incentive subcontracts, such as fixed-price with incentive, will be considered when a reasonably firm basis for pricing does not exist or the nature of the requirement is such that the subcontractor's assumption of a degree of cost risk will provide a positive profit incentive for effective cost and/or schedule control and performance.

8. Acquisition Streamlining

The procurement systems and processes to streamline these projects are already in place. The projects will use the DOE-approved procurement system at Fermilab. Commercial and best business practices will be used to accomplish all procurements.

Procurements will use best value source selection concepts allowing cost and technical tradeoffs to ensure the best value is obtained in acquiring technical components and capital/scientific equipment. Fermilab has the staff and is organized to perform these procurements. Fermilab gained considerable experience in the procurement of the type of detector elements that are included in these projects during the Run IIa CDF and DØ Upgrade Projects.

B. Plan of Action

1. Sources

The primary source of materials for these projects will be commercial vendors vying for purchase orders under competitive conditions. Some components will be provided by universities or foreign-funding sources under MOU developed by Fermilab. Ultimate technical, schedule, and cost will be controlled by the project team. Labor will come from both university and Fermilab staffs. Davis Bacon Act requirements will be applied appropriately.

2. Competition

All actions will be competitive unless specifically authorized by the project managers and in accordance with the DOE-approved Fermilab procurement policies and procedures.

3. Source Selection Procedures

The source selection for all procurements is guided by Fermilab procurement procedures.

(1) Competition

Fixed-price purchase orders and subcontracts for supplies, equipment and services will be awarded on the basis of competitive solicitations. Such awards shall be made to offerors deemed technically responsive and responsible by project and procurement representatives. Awards made on a non-competitive basis will include adequate justification to support such award in accordance with Fermilab procurement procedures. For critical components required in quantity, multiple contracts with options exercisable by Fermilab may be utilized to obtain best value.

(2) Solicitation Documents and Evaluation Criteria

The means of soliciting offers will be the Request for Quotation (RFQ) and the Request for Proposal (RFP). The nature, complexity and/or dollar value of each procurement will determine the type of solicitation to be used.

All major or highly technical procurements will, when appropriate, have a plan for evaluating proposals and evaluation criteria for ranking of prospective vendors or subcontractors who are competing. Criteria for evaluation will be based on technical, business and overall cost factors including technical capability, past performance, capacity, and delivery, as well as subcontractor responsiveness to the solicitation and subcontractor responsibility factors such as financial means.

These evaluation criteria will relate directly to the specification and/or Statement of Work. The plan will include the criteria for the technical evaluation. Evaluation criteria will be established prior to the distribution of the solicitation.

The general criteria will become a part of the solicitation so that all potential offerors will reasonably know how the proposals will be evaluated.

4. Contracting Considerations

A Statement of Work (SOW) or specification will be required for all procurement actions. The content and detail of each SOW or specification will fully define or describe the proposed procurement.

(1) Use of functional or performance specifications.

The projects anticipate that a major portion of the technical design will be done in-house, leaving little design work for outside vendors. Procurements will primarily consist of fabricated items, state-of-the-art items, and off-the-shelf items. Functional or performance specifications will be used, to the extent practicable, for procurement of materials and services.

(2) Consolidation and standardization.

It is the intent of the project to consolidate standard like-items in order to reduce the number of orders handled and to obtain quantity or volume discounts as long as delivery and schedule can be met.

(3) Special Provisions

Except for the utilization of unilateral options as discussed in section A.3 (Source Selection Procedures) above, the project does not anticipate that special contractual provisions will be required for this project.

5. Budgeting and Funding

The projects will receive the majority of the funding from DOE via the Fermilab budget. Significant contributions from foreign sources are anticipated. In addition, several university groups will contribute to the projects and be supported by National Science Foundation grants. Labor for the Run IIb Collider Experiment projects will be provided by Fermilab and university supported researchers. Additional details are provided in Appendices A and B.

6. Product or Service Descriptions

Each project will deliver a completed radiation hard silicon tracking detector for use in Run IIb. These detectors are the largest single subprojects in each project. Other smaller deliverables are detailed in Appendices A and B.

7. Priorities, Allocations and Allotments

There are no unique priorities, allocations or allotments associated with the procurement of the Run IIb collider projects.

8. Contractor vs. Government Performance

All work associated with the Run IIb projects will be performed by contractor (Fermilab) or subcontractor personnel. Fermilab will award all contracts to commercial firms, universities, and research laboratories. There is no apparent advantage for DOE to directly handle the Run IIb procurements.

9. Inherently Governmental Functions

There are no inherently governmental functions associated with the Run IIb projects.

10. Management Information Requirements

Project procurements will include status reporting requirements. The extent of reporting is commensurate with the value of the procurement. Major project procurements will require general management, schedule/labor/cost, exception, performance, financial, and technical status reports which are consistent with this type of procurement. The type (technical/cost/schedule) and frequency of progress information and follow-up required will depend on such factors as the complexity of the procurement and how critical the work is to the project schedule. These periodic reports, along with on-site visits, will be the major tool for evaluating progress. The projects will maintain a comprehensive procurement follow-up program tracking all aspects of the procurement cycle. Earned value details will be required from vendors on major procurements that include progress payment provisions.

11. Make or Buy Considerations

Fermilab will comply with the Make or Buy Program set forth in the DOE/URA prime contract. Fermilab will buy most components of the Run IIb projects, since technical expertise for making many required elements at Fermilab is not available. These components will be assembled by technicians at Fermilab into the custom units that are the final detector subsystems. Fermilab has the infrastructure in place and the experience to perform this work successfully. These projects are science projects, not civil construction projects, and therefore, the involvement of scientists is critical in the assembly of these subsystems into the precision measurement devices required during Run IIb.

12. Test and Evaluation

The project teams will determine the items to be procured. The teams will develop technical requirements and specifications, including test and evaluation requirements.

13. Logistic Considerations

No unique logistical considerations are anticipated for the Run IIb projects.

14. Government Furnished Property

No government-furnished property is anticipated on these projects. If the need arises in the future, it will be provided in accordance with the DOE-approved Fermilab property management system.

15. Government Furnished Information

These projects do not anticipate making use of any government supplied information.

16. Environmental and Energy Conservation Objectives

The energy needs and environmental impact of these projects is negligible. No specific objectives have been identified.

17. Security Considerations

The security oversight for the overall site is Fermilab's responsibility. Access to and from the job site is controlled by standard site access requirements. None of the work is classified.

18. Safety Requirements and Considerations

Fermilab subscribes to the philosophy of Integrated Safety Management (ISM) for all work conducted on the Fermilab site and requires its subcontractor and sub-tier contractors to do the same. Integrated Safety Management is a system for performing work safely and in an environmentally responsible manner. The term "integrated" is used to indicate that the ES&H management systems are normal and natural elements of doing work. The intent is to integrate the management of ES&H with the management of the other primary elements of work: quality, cost, and schedule.

19. Contract Administration

The DOE Run II Project Manager will monitor and evaluate project performance against technical, cost, and schedule baselines as specified in the Project Execution Plan. Environment, safety and health performance will also be monitored via the existing Fermi Area Office ES&H oversight program.

The Fermilab Procurement Department established within the Business Services Section will implement all aspects of procurement using DOE-approved Fermilab procurement policies and approval authority guidelines.

Authorization to approve purchase requisitions, stores requests and service requests will be controlled by the Fermilab signature authorization system. The Procurement Department will procure all material, fabricated items, equipment, and services. It will also subcontract Research and Development authorized by either the Project Manager or Project personnel possessing the requisite signature authority.

The manager of the Procurement Department will assign specific procurements to Procurement Administrators having the skills and expertise to best handle the requirement.

The Procurement Department will be responsible for administering the pre-solicitation, solicitation, evaluation, negotiation, award, and subcontract administration activities, including expediting and close-out.

20. Other Considerations

Several of the more technically challenging and/or riskier elements to be procured by the two projects are being closely coordinated, in order to reduce the schedule risk and cost in the procurements. Specific examples include the SVX4 readout chip, which will be used in the silicon detectors of both experiments; the beryllium beampipes; and the silicon sensors. Technically risky items have been scheduled with extra contingency in both time and cost, in the event that extra prototype cycles are required.

21. Milestones in the Acquisition Cycle

The significant milestones for procurement are detailed in Appendix A and B.

22. Integrated Project Team

The following is the initial membership of the Run IIb CDF and DØ Detector Projects Integrated Project Team. This team participated in the writing of the Acquisition Execution Plan.

Mike Procario, DOE Program Manager
Paul Philp, DOE Run II Project Manager
Patrick Lukens, Run IIb CDF Project Manager
Jon Kotcher, Run IIb DØ Project Manager
Doug Benjamin, Run IIb CDF Deputy Project Manager
Rich Partridge, Run IIb DØ Deputy Project Manager
Joe Collins, Fermilab Procurement
Ed Temple, Fermilab Project Oversight

Appendix A: The Run IIb CDF Detector Project

The CDF detector is the older of the two experiments and is located on the interaction point designated as "B0" by the accelerator group. Three primary subprojects are anticipated for the Run IIb project to provide equipment to replace existing equipment that will no longer meet the needs of the experiment: a silicon detector, a central preradiator detector, and upgraded data acquisition and trigger systems. The current cost estimate with contingency is given in Table A-1 for primary subprojects.

Table A-1: Estimated Cost for the CDF Run IIb Project Primary Subprojects

Subproject	Estimated Cost (in M$)
Silicon Tracker	$17-20
Calorimeter Upgrades	$1.4-1.6
Data Acquisition Upgrades	$4.5-5.5

Major Procurements

A list of the major procurements anticipated for the CDF Run IIb project with current estimated bid release dates appears in Table A-2. These are procurements whose estimated cost exceeds $100,000 and/or are seen as containing a significant degree of risk.

Table A-2: Major Procurements in Fiscal Years 2002-05

Description	Bid Release Date
SVX4 Chips	January 2003
Outer Layer Hybrids	July 2003
Layer 0 Hybrids	August 2003
Layer 1 Hybrids	April 2003
Bus Cables	January 2003
MiniPortcards	January 2003
Cables	March 2003
Fiber Transition Module	November 2003
Power Supplies	September 2003
SVT Trackfitters	October 2003
Sensors	October 2002
Layer 0 Cables	July 2003
Phototubes and Bases	December 2002
32 Port ASX 4000	July 2004

CDF is an international collaboration of 55 institutions, representing eight countries. It is anticipated that a number of procurements needed for the project will be made through collaborating institutions, due to the technical expertise available. Memoranda of Understanding (MOU) will be established with the collaborating institutions to establish responsibilities for the procurements they coordinate. In every instance where a collaborating institution provides goods or services to the project, the Memorandum of Understanding established between Fermilab and the institution will assure that the Project Manager has oversight of the work performed and can establish specifications for acceptance of the work or goods provided.

Appendix B: Run IIb DØ Detector Project

The DØ detector was first brought into operation in 1992 and had a very successful "Run I" data run during 1992-1996. The detector underwent a major upgrade, completed in 2001, in preparation for the Run IIa data run which will continue until approximately 2005.

The goal of the DØ Run IIb upgrade is to provide equipment to extend the usable lifetime of the detector and allow operation at high luminosities required to meet the goals of the Run IIb physics program outlined in Section A.1 (Statement of Need). The largest of the upgraded equipment provided by this project is the Silicon Tracker replacement, which is needed because of the significant radiation damage to the present silicon tracker during Run IIa. In addition, equipment is provided to upgrade the trigger and online systems to allow operation at the high luminosity expected in Run IIb and upgrades to the online computing system to provide continued operation. Table B-1 lists the estimated cost of these upgrades (including contingency).

Table B-1: Estimated Cost for the DØ Run IIb Project Primary Subprojects

Subproject	Estimated Cost (in M$)
Silicon Tracker	$22-25
Level 1 Upgrade	$4-5
Level 2 Upgrade	$0.9-1.5
Online Computing	$0.9-1.5

Major Procurements

A list of the major procurements anticipated for the DØ Run IIb project with current estimated bid release dates appears in Table B-2. These are procurements whose estimated cost exceeds $100,000 and/or are seen as containing a significant degree of risk.

Table B-2: Major Procurements in Fiscal Years 2002-05

Description	Bid Release Date
Layer 0 Sensors	July 2003
Layer 1 Sensors	February 2003
Layer 2-5 Sensors	December 2002
SVX4 Readout IC's	May 2003
Layer 0 Hybrids	February 2003
Layer 1 Hybrids	May 2003
Layer 2-5 Hybrids	June 2003
Analog Flex Cables	February 2003
Digital Jumper Cables	September 2003
Junction Cards	January 2004
Twisted-Pair Readout Cables	November 2003
Digital Filter Parts	May 2003
Trigger Algorithm Parts	June 2003
Track Trigger FPGAs	April 2004

Over 600 physicists from 73 institutions in 18 countries are currently members of the DØ collaboration that utilizes the data acquired by the DØ detector for producing scientific results.

Many of the collaborating physicists and institutions have played major roles in the construction of the present DØ detector and in the planning for the Run IIb upgrade. Many elements of the Run IIb upgrade require highly specialized expertise for design and construction that can only be obtained in the collaborating institutions.

In addition to DOE funding, the DØ Run IIb project is partially supported by NSF and DØ collaborating institutions. As a result of this outside support, some procurements will be performed by these collaborating institutions. Memoranda of Understanding (MOU) will be executed between Fermilab and collaborating institutions that detail the work to be performed by each institution. The MOU will also describe the approval process for procurements to ensure full oversight by the Project Manager. An NSF Major Research Instrument (MRI) grant has been awarded to a consortium of eight US universities that provides partial funding for the Silicon Tracker Replacement. In addition to the NSF funding, cost sharing funds have been committed to the project by the collaborating universities and two foreign institutions. A second NSF MRI proposal is pending that requests partial funding for the Trigger Upgrade.